Section 2g tests for ions and gases

1. Cations

Flame tests

Aim

To carry out the flame test on the chlorides of lithium, sodium, potassium, calcium and copper.

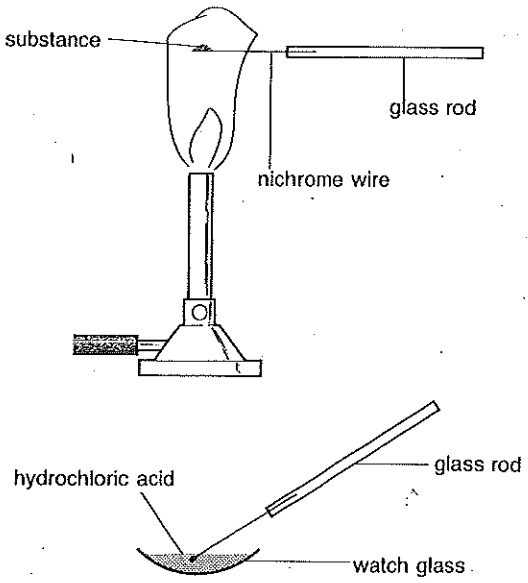
Apparatus and materials

Nichrome wire 6 cm secured in a glass rod
Bunsen burner and mat
Hydrochloric acid, a 1 : 1 mixture of concentrated acid and water.
Watch-glass
Lithium chloride
Sodium chloride
Potassium chloride
Calcium chloride
Copper(II) chloride
Unknown salts, A-E

Precaution

Hydrochloric acid is very corrosive. If any of the acid is spilled on the skin it should be washed off immediately with a large amount of water.

Procedure



1 Adjust a Bunsen burner flame so that the gas supply is low and there is a medium flame. Adjust the air hole to produce a non-luminous flame. Do not create a 'roaring' flame.
2 Clean the tip of the nichrome wire. Heat it to red heat in the Bunsen flame. Dip it into a small amount of hydrochloric acid contained in a watch-glass. Repeat this procedure until the nichrome wire no longer colours the flame.
3 Moisten the nichrome wire by dipping it in the acid.
4 Dip the wire into a small sample of lithium chloride. Check to see that some solid is sticking to the wire.
5 Place the end of the wire in the Bunsen burner flame. Describe the colour produced.
6 Repeat step **2** to clean the wire and carry out steps **3**–**5** with the other chlorides.
7 Examine the unknown compounds A–E and find out which metal ion is present in each compound.

Results

Copy and complete the following tables. Describe the flame colour as accurately as possible. Do not give a one word description.

compound	metal ion (cation)	description of colour
lithium chloride	Li^+	
sodium chloride	Na^+	
potassium chloride	K^+	
calcium chloride	Ca^{2+}	
copper(II) chloride	Cu^{2+}	

Using sodium hydroxide

1. Add 2 cm copper (II) sulphate solution to a test tube. Fill up the test tube to 1 cm from the top. Record your observation.

2. Repeat step 1 for iron (II) nitrate and iron (III) chloride.

cation	addition of sodium hydroxide
Cu^{2+}	
Fe^{2+}	
Fe^{3+}	

2. Anions

Aim

To carry out tests for carbonate, sulphate and chloride and test for these anions in a series of 'unknowns'.

Apparatus and materials

Four test-tubes
Test-tube rack
Spatula
Dilute nitric acid, 2 mol dm $^{-3}$
Barium chloride solution, 0.02 mol dm $^{-3}$
Limewater
Silver nitrate solution, 0.02 mol dm $^{-3}$
Sodium chloride crystals
Calcium carbonate powder
Potassium sulphate crystals
Unknowns, A-J

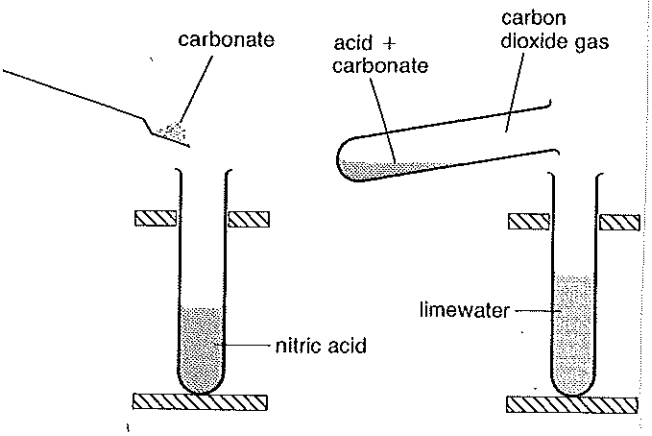
Precautions

Thoroughly wash out each test-tube after use in each test. Traces of chemicals remaining in a test-tube may interfere with the next test.

Procedure

a) Carbonate test

1 Half fill a test-tube with limewater.
2 Place a level spatula measure of calcium carbonate in another test-tube.
3 Add sufficient dilute nitric acid to cover the solid. Continue to add acid taking care that the effervescence does not force the acid out of the test-tube.
4 Pour the carbon dioxide into the test-tube of limewater.



5 Note whether the limewater turns milky.

b) Sulphate test

1 Place a level spatula measure of potassium sulphate in a test-tube.
2 Add dilute nitric acid to the solid until the test-tube is half full.
3 Shake the test-tube to dissolve the solid.
4 Add one or two cm^3 of barium chloride solution to the solution of the solid.
5 Note whether a white precipitate is produced.

c) Chloride test

1 Place a level spatula measure of sodium chloride in a test-tube.
2 Add dilute nitric acid to the solid until the test-tube is half full.
3 Shake the test-tube to dissolve the solid.
4 Add about 2 cm^3 of silver nitrate solution to the solution.
5 Note whether a white precipitate is produced.

add dilute nitric acid

gas given off	gas not given off
↓	↓
test the gas with limewater	divide the solution into two parts: part I: add barium chloride solution part II: add silver nitrate solution

Results

Copy and complete the following tables:

unknown	anion present
A	
B	
C	
D	
E	

2 Write equations for the carbonate, chloride and sulphate tests with sodium carbonate, sodium chloride and sodium sulphate.

3 **a)** Copy and complete the following analysis tables.

b) Identify the following three salts.

Salt A

test	**result**	**conclusion**
flame test	green blue colour	
addition of dilute nitric acid	effervescence	
addition of sodium hydroxide solution	green blue precipitate	

Salt B

test	**result**	**conclusion**
flame test	lilac colour	
addition of dilute nitric acid	solid dissolves	
addition of dilute nitric acid and silver nitrate solution	white precipitate	

Salt C

test	**result**	**conclusion**
flame test	yellow colour	
addition of sodium hydroxide solution	no precipitate	
addition of dilute nitric acid	solid dissolves	
addition of dilute nitric acid and barium chloride solution	white precipitate	